13. Contributions to the Anatomy and Systematic Arrangement of the Cestoidea. By Frank E. Beddard, M.A., F.R.S., F.Z.S., Prosector to the Society.

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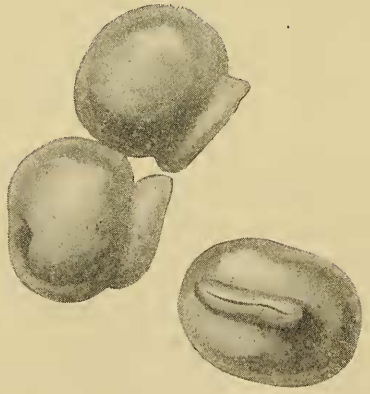
(Text-figures 19–30.)

III. On a New Genus of Tapeworms (*Otiditænia*) from the Bustard (*Eupodotis kori*).

An example of the South-African Bustard (*Eupodotis kori*) on April 27th, 1911, voided a number of white curiously-shaped bodies, the nature of which I did not recognise until they were submitted to microscopic examination. The shape of these bodies may be learnt by an inspection of text-figure 19. They are separate mature proglottids of a tapeworm, of which I obtained complete specimens later (on May 7th), when the bird died. Since the Bustard was acquired by the Society on October 1st, 1910, it seems likely that the infection did not take place in the Society's Gardens, but that the parasites were already present when the bird arrived.

Text-fig. 19.



Ripe and detached proglottids of *Otiditænia eupodotidis*.

A most useful and presumably comprehensive list of the tapeworms of birds has been quite recently published by Prof. Fuhrmann *. From this it would appear that only the following species have been found in the Otidiformes, and that none at all have been met with in *Eupodotis kori*—if it has been examined from this

* "Die Cestoden der Vögel," Zool. Jahrb. 1908, Suppl.-Bd. x.

point of view. The species are *Idiogenes otidis*, *Chapmannia lapica*, *Hymenolepis villosa*, *H. tetracis*, and *H. ambiguus*. There is no doubt that the species which forms the subject of the present communication to the Society is none of these; nor can I reconcile its characters with those of any other genus of Tapeworms of the group Tetracotylea (of which group it is undoubtedly a member) which have been described up to the present. I shall, however, defer the attempt to fix its systematic position until I have described its anatomical characters.

I have examined four complete specimens of this worm, besides some fragments which may or may not have belonged to those specimens. The largest was about 3 inches in length, and the greatest diameter of the posterior segments was 4 mm. The diameter of the body gradually increases from the head up to the point of greatest diameter, and then remains the same; there is not, as in so many tapeworms, a narrow anterior region of the body, which suddenly widens within the limits of two or three proglottids. The general shape is thus much like that of certain species of *Bertiella*, for example of *B. cercopitheci* *. There is, however, no further resemblance between the present genus and *Bertiella* in external form. The worm is white in colour; but there is some black pigment in the head behind the suckers, and the ripe proglottids are of a brick-red hue.

The *scolex* of this new worm—for which I propose the generic and specific names of *Otiditænia eupodotidis*, as indicative of its habitat—is not particularly small nor, on the other hand, conspicuous by its large size. I have not found the least trace of hooks anywhere on the suckers. The head seems be completely unarmed as to the suckers, but the rostellum has hooks.

The four *suckers* are, as is so often the case, extremely mobile, and can be protruded a long way from the head as cylindrical processes. In this case they look rather forwards than outwards. When retracted and in a normal condition the suckers look outwards and slightly upwards. When fully protruded the suckers give to the head of this worm an appearance very like that of the genus of Tetraphyllidea, *Cylindrophorus* †.

I have investigated the structure of the rostellum and lateral suckers by transverse sections through the head. There is nothing remarkable about the structure of the suckers. The *rostellum*, however, demands some consideration. When the worm is examined with a lens or with a low power only of the microscope, the appearance presented is that of a median sucker such as occurs sometimes, though, as it is stated by Küchenmeister ‡, not always, in *Tænia saginata*. The hooks are, in fact, so minute that I was unable to detect them when studying the worm in that fashion. Nor can they be detected save with high-powered lenses. The varying condition of the retraction of the median sucker, or rather

* See Beddard, P. Z. S. 1911, p. 640, text-fig. 151.
† Bronn's 'Klassen u. Ordnungen des Thierreichs,' Bd. iv. Taf. 42. fig. 14.
‡ 'Die Parasiten des Menschen,' Leipsic 1881, p. 140, pl. ii. fig. 3.

rostellum, renders it apparently absent or more feebly developed in some individuals than in others. And there is here a resemblance to the otherwise not closely allied *Tœnia saginata*.

This median sucker is, indeed, a not much more developed structure than the rudimentary rostellum of *Tœnia saginata*. In this latter species Railliet* speaks of "le rostre faisant défaut et se trouvant remplacé fréquemment par une légère dépression"; while Leuckart †, in defining the species, states that "the head has a flattened crown with a pit-like hollow in the middle." On the other hand, Küchenmeister, while emphasizing the occasional absence of any such depression in both text and figure, also figures ‡ an organ very like a sucker, and certainly more than a mere depression. The structure, however, is not, according to Leuckart §, a sucker, but a rudimentary rostellum with a distinct lenticular muscular mass. Leuckart's figure of a section through this "sucker" is copied in Bronn's 'Thierreichs' (Bd. iv. p. 1203).

The accompanying text-figure (text-fig. 20) shows a median longitudinal section through the scolex of *Otiditœnia*, illustrating the rudimentary rostellum and enabling it to be compared with the adjacent suckers. The simplicity of the really sucker-like rostellum will be apparent from this figure, which represents the rostellum in a contracted state withdrawn into the scolex. Inasmuch as the setæ border the rostellum in a double circle, they are not visible in such a preparation, only one or two being seen in each section at the two corners of the rostellum. The rostellum itself is obviously (to my mind) no more, or very little more, developed than that of *Tœnia saginata*, already referred to; its muscular layer is not thicker than that of the suckers, as will be seen from my figure. This obviously contrasts greatly with complicated and more typical rostella ‖.

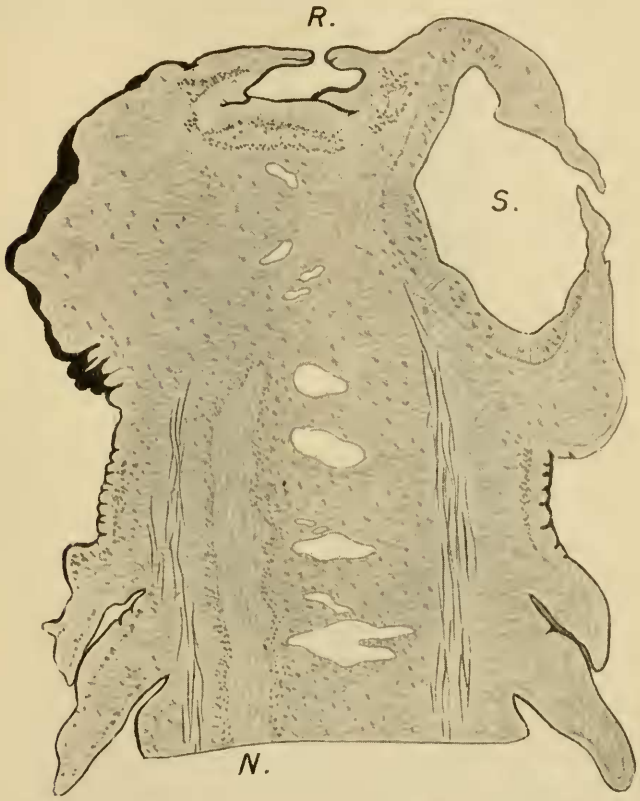
It will be observed, moreover, that the floor of the cavity into which the rostellum is retractile—which floor constitutes the rostellum—is hardly, if at all, thicker than the lateral walls of the cavity; that the whole structure, in fact, does not greatly differ from a sucker. It may be borne in mind that this is a possible origin of the rostellum, though the theory that it is the metamorphosed remains of a pharynx has been put forward. On the other hand, the nuclei are more densely packed in the rostellum than in the suckers, as the figure referred to shows. This difference is, however, perhaps partly due to the more contracted condition of the rostellum, and possibly also to its greater contractility. Again, the layer of chitin covering the rostellum is very much thicker than that which lines the suckers—the latter being, indeed, inappreciable. There is some black pigment in the head behind the suckers.

My preparations unfortunately do not allow me to give any

* 'Traité de Zoologie Médicale et Agricole,' ed. 2, Paris 1895, p. 232.
† 'The Parasites of Man' (Engl. ed. transl. by Hoyle), Edinburgh 1886, p. 407.
‡ *Loc. cit.* pl. vi. fig. 8.
§ *Loc. cit.* p. 435.
‖ *Cf., e.g.*, Bronn's 'Thierreichs,' Bd. iv. figs. 56, 57, 58, pp. 1326–1328.

accurate account or figures of the rostellar hooks. I can only say that they are curved and hook-like, *not* straight, and very numerous, certainly at least 150 in number, and probably more, and that they are disposed in an alternating fashion, forming a double crown.

Text-fig. 20.



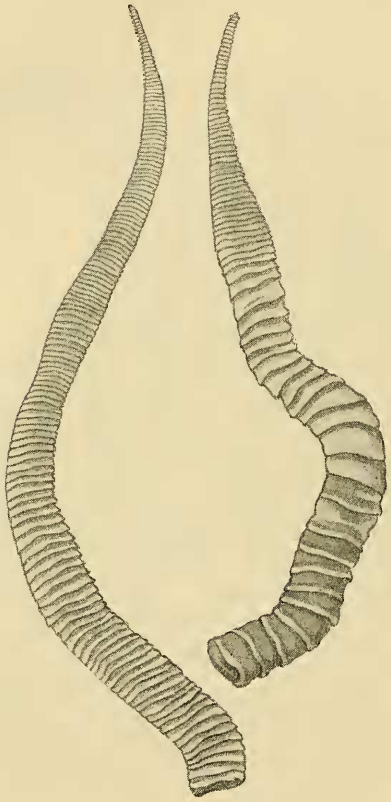
Longitudinal section through scolex of *Otiditænia eupodotidis*.

R. Rudimentary rostellum (the hooks are too small to appear). *S.* One of the suckers. *N.* Lateral nerve-cord of one side.

The longitudinal section from which the annexed text-figure of the rostellum was drawn also shows very well the existence of a neck in this tapeworm. It varies much in length, though it is never longer than the length of three or four proglottids immediately following upon it. On the other hand, it is sometimes very short, not more than the length of the first proglottid. If this had not been observed in the living worm, where the neck is much more distinct, as such, from the proglottids than in alcohol-

preserved material, it might easily be supposed that this species was characterised by the absence of a neck. Such a mistake may have been made with other species.

Text-fig. 21.

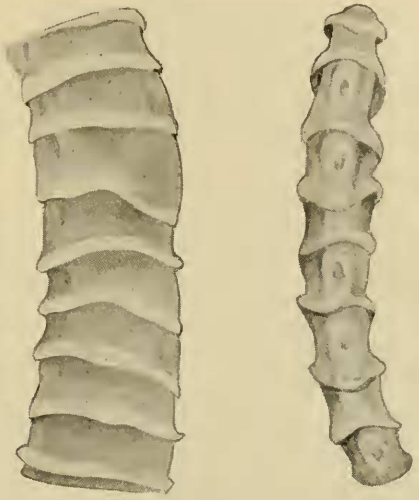


Two examples of *Otiditænia eupodotidis* differing slightly in progressive increase of size of proglottids.

The general character of the segmentation and the form of the individual proglottids is shown in text-figure 21, which represents two individuals which are slightly different in these characters. In one of them the segments increase in length more rapidly than in the other; but in neither are the posterior segments longer than they are broad. Nor do they even get to be so long, except in the case of the detached proglottids. As the segments advance towards maturity the projection of one segment over that which follows is seen to be more marked, and it forms quite a sharp-edged frill, as is shown in the drawings referred to. The completely

mature proglottids are represented in several aspects in text-figure 19 (p. 194). These proglottids, as there depicted, have a very peculiar form, and have quite lost the flattened appearance of the anterior region of the strobila. They are, indeed, almost spherical in general outline. The projecting frill remains, but its edges are closely adpressed. A single proglottid presents much the appearance of a full sack with the lips of the mouth closely drawn together.

Text-fig. 22.



Left-hand figure a ventral view of eight nearly mature proglottids of *Otiditænia eupodotidis*.
Right-hand figure a lateral view of the same showing genital pores.

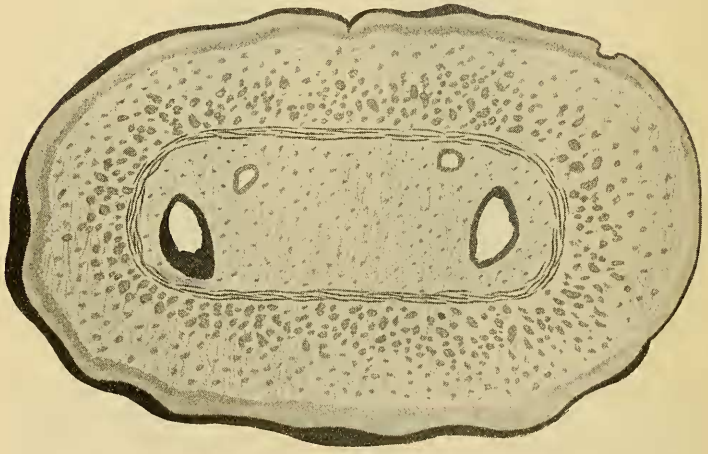
The last external character to be noticed is the position and character of the genital pores. These are irregularly alternate. The pores are simple orifices upon the lateral surfaces of the proglottids, and are not in any way prolonged into a spout-like outgrowth. They are, however, situated on an area which covers the whole of the lateral face of the segment, and is slightly raised; it is also whiter in colour than the rest of the (rather yellowish) body. Finally, the segment is longer from before backwards on the side which bears the genital pore; this inequality of the two sides of a segment enables the position of a genital pore to be fixed without actually inspecting the orifice (text-fig. 22).

In transverse sections of the body before the reproductive organs are to be seen, except in rudiment, the cortical parenchyma will be observed to be fully as thick as the medullary parenchyma. Indeed, anteriorly in the segment before the overlapping frill has detached itself the cortical parenchyma is actually the thicker. The longitudinal muscle-fibres seen in this layer are disposed

singly in the more peripheral regions; more centrally they are aggregated into bundles, the number of fibres being larger in the deeper strata. In the largest I have counted 14 or 15 fibres. Within this layer and bounding the medullary parenchyma is a layer of delicate circular fibres. In older proglottids the number of longitudinal fibres to a bundle may be considerably greater and the strength of the circular layer has increased. This latter fact is particularly to be noted in the segments which are nearly ready for detachment.

The *water vascular tubes* are the usual four longitudinal trunks, of which—as is again usual—the dorsal is smaller and has much thicker walls. The larger ventral tubes are connected by a rather wide commissural vessel in each segment. The dorsal vessels are apt to vary a little in their relation to the ventral vessels; but they are never superposed, *i. e.* directly dorsal and ventral to each other. The dorsal vessel, in fact, lies to the inside of the ventral

Text-fig. 23.



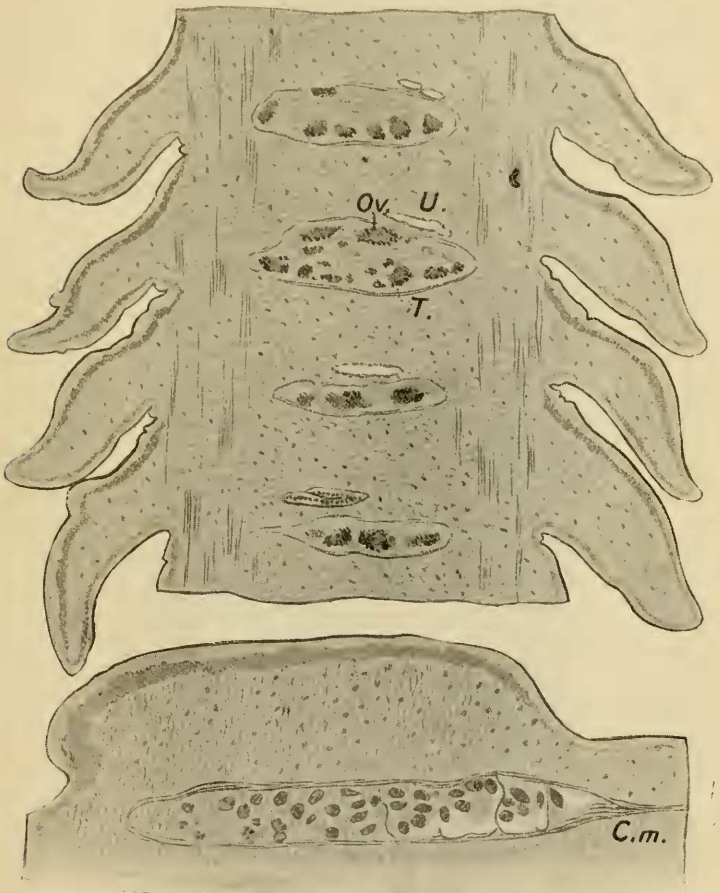
Transverse section through an immature proglottid of *Otiditænia eupodotidis*. The larger ventral water vascular tubes lie below and rather to the outside of the smaller dorsal vessels.

vessel, sometimes absolutely parallel with it and sometimes more dorsally inclined. The capacity of the large ventral vessel tends to vary; I have seen it to be almost obliterated for a short space. In the anterior segments of the body there is much less difference in calibre between the water vascular vessels than is to be seen later.

The *testes* of this tapeworm lie quite posteriorly in the segment, and thus behind all the other parts of the generative system. In sagittal sections of young proglottids in which the testes are mature or nearly so, but in which the uterus is not yet much

developed, a straight line joining the posterior angles formed by the outgrowths of the segments dorsally and ventrally is just in contact with the posterior boundary of the mass of testes. Anteriorly they are well separated from, though very close to, the ovaries. The testes, in fact, in the genus described in the present paper do not straggle over the segment as they are represented to

Text-fig. 24.



Upper figure a horizontal section through four not completely ripe proglottids of *Otiditænia eupodotidis*.

Ov. Ovary. *T.* Mass of testes. *U.* Uterus.

Lower figure a portion of a transverse section through a proglottid, showing the division of the layer of circular muscles (*C.m.*) to enclose the young uterus.

do in the allied genus *Choanotænia*—for example, in the species *Ch. galbula* and *Ch. infundibulum* figured by Cohn *.

Text-fig. 25.

Horizontal section through three not fully mature proglottids of *Otiditænia eupodotidis*.

d. Dorsal water vascular tube. *W.* Ventral ditto. *T.* Mass of testes. *U.* Uterus.

* "Zur Anatomie etc. der Vogelcestoden," Nova Acta Ac. Nat. Curios. lxxix. 1901 pl. 31. fig. 40 & pl. 32. fig. 47.

The testes of *Otiditænia* (text-fig. 24, p. 201) form, in fact, a very compact mass, which almost suggests a single organ whose compactness and general characters form a very distinguishing mark of this genus. In the sagittal sections already referred to, the mass of testes is seen to form a band rather lenticular in outline, *i. e.* tapering dorsally and ventrally, which extends without intermission from the dorsal to the ventral muscular body-wall. In transverse sections of the worm the testicular mass is seen equally well to form an unbroken dorso-ventral layer occupying the whole of the central parenchyma between the larger ventral water vascular vessels, to the outside of which the testes do not extend. The wall of testes which thus exists—marking, as has already been said, the posterior region of the proglottid—is a very thin one. It is formed of only a single layer or in parts of two layers of testes.

In their general form the testes are oval. The very small amount of space occupied by the testes in an antero-posterior plane is striking; but it is greater in the less fully than in the more fully mature proglottids. In the former the antero-posterior diameter of the group of testes is a little more than one-third of the length of the segment; in the latter perhaps one-tenth, and the disproportion becomes even greater in absolutely ripe segments, where, indeed, the testes finally disappear, being apparently pressed out of existence by the swelling proglottids.

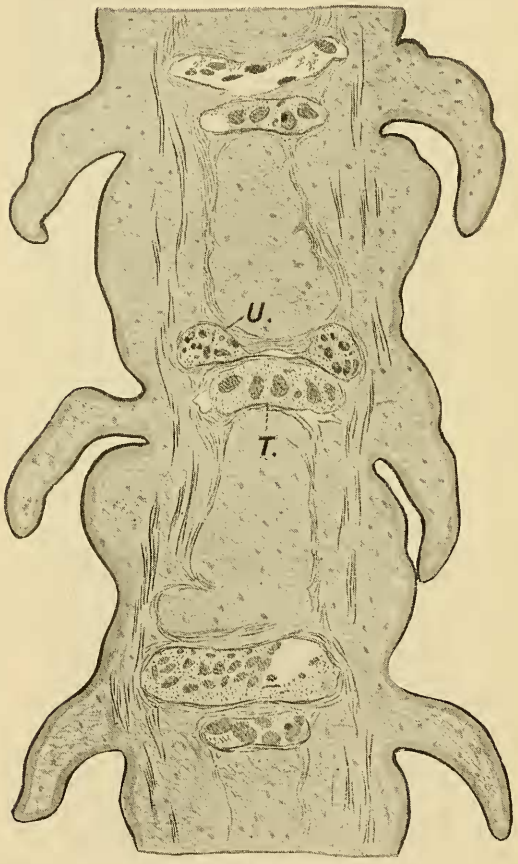
In such tapeworms as I am acquainted with by first-hand knowledge the testes are scattered in the medullary parenchyma, though often closely adpressed; but there is no particular modification of the medullary parenchyma in the region occupied by the testes. The same conditions appear to obtain in many forms described by others.

In *Otiditænia*, however, the testes lie in a very distinct cavity, which has in sagittal sections of the entire proglottid a lenticular outline already mentioned. This cavity is not everywhere apparent as actual spaces lying outside of the testes; it is for the most part filled up with an interstitial tissue, which separates the individual testes and in which they lie closely packed together. Although this interstitial tissue is not very different in appearance from the medullary parenchyma, it is separated from it by a distinct boundary-line and is more faintly stained by carmine, and does not seem to contain any calcareous corpuscles. The distinctness of the mass of testes, as a whole, from the surrounding regions of the proglottid will be apparent from text-figure 26 (p. 204). Here and there the interstitial tissue seems to be replaced by actual cavities which contain no fluid that takes a stain. They appear, in fact, to be empty.

Since the testes lie quite posteriorly in the segments, it is obvious that they must be close to the transverse vessels of the water vascular system, which unite the ventral vessels. The spaces to which I have referred, I believe, entirely belong to the transverse water vascular trunks which are large in the

present species. Though the individual testes appear at first sight to be actually bathed by the fluid of the excretory tube, a more careful examination has always shown a layer of interstitial tissue separating the actual testes from the water vascular spaces. The testes, however, do project with their covering into the spaces (see text-fig. 25, p. 202) here and there, and there is thus a very close anatomical relation between them.

Text-fig. 26.



Sagittal section through three proglottids of *Otiditænia eupodotidis*.

T. Mass of testes. *U.* Uterus.

In longitudinal horizontal sections (text-fig. 25) it is obvious that the testes of *Otiditænia* form a layer which is, as a rule, only one thick, though here and there two testes lie one in front of the other. The distinction between the interstitial tissue separating

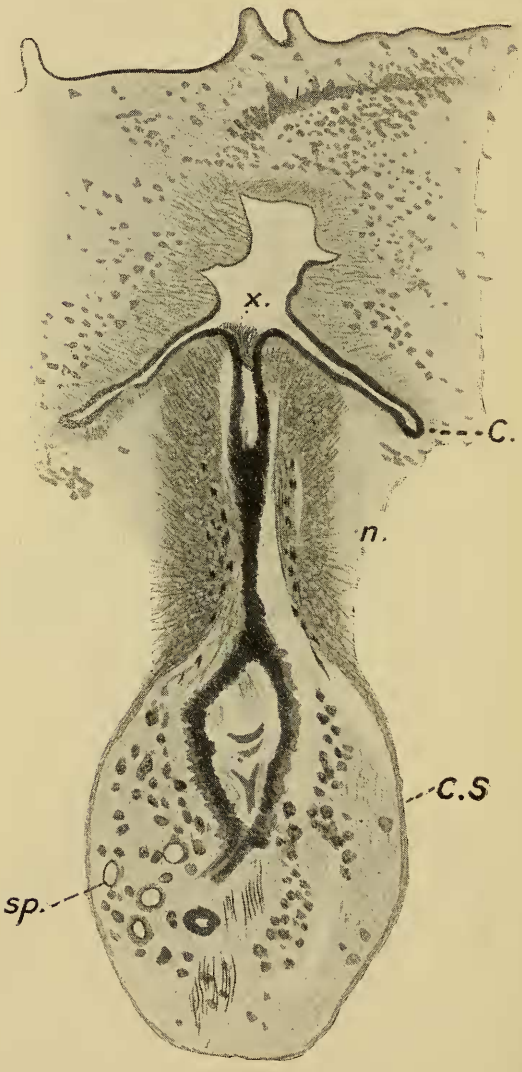
the individual testes and the general medullary parenchyma is strikingly obvious in such sections, inasmuch as the whole area can be seen in a single section extending from one side of the body to the other. Such sections also show particularly well the fact that the testes extend rather beyond the large ventral water vascular vessel on the fore side, where, indeed, they occasionally nearly touch the outer skin. The extension is not quite so great on the opposite side, though the mass of testes usually bulges into the vessel, and, as already mentioned, presents very much the appearance of lying in it. It is to be noticed also that in these lateral extensions of the testes the whole mass gets very much wider from back to front, the testes being three or four deep. These outgrowths intrench upon the area occupied by the coils of the vas deferens, and push laterally and flatten out that coil. The extension of this testicular mass laterally is highly suggestive of its being a single organ growing as a whole and not merely an association of separate and quite individualized testes. The interstitial substance which divides the testes presents the appearance in the direction of its fibrils of having flowed laterally, carrying with it the enclosed testes. Multiplying the 30 or so testes which are visible in a horizontal section by the 6 or 7 which are visible in a sagittal section, we get a total of 200 or so, which may be slightly increased to include the testes found in the lateral extensions of the testicular area just referred to.

The *ovaries* are very obvious in the segments where they occur; but they disappear early in the strobila and are represented thenceforward by mere vestiges. The ovaries are to the fore side of the segment and closer to that margin of the strobila than the vitelline gland, to which, however, they are closely contiguous. They commence on the level of the receptaculum and lie on both dorsal and ventral sides of that portion of the oviducal tube, hence getting a double character—the ventral half (or more ventral ovary, if we speak of two) is considerably the larger. They lie posteriorly in the segment, but between the testes and the uterus. They by no means occupy the whole breadth of the medullary parenchyma in a sagittal section, as do the testes when fully developed.

The *cloaca genitalis* opens on to the exterior directly. There is no papilla-like process bearing a genital orifice. As already mentioned, the pores are irregularly alternate in position, and I have seen as many as six consecutive pores on the same side of the body. The cavity of this conjoined region of the genital ducts is rather wide and of some length; the lumen is slit-like to circular, but the walls never seem to be crumpled so as to give a star-like appearance to the lumen. The cavity is lined by a very thick layer of cuticle which stains very deeply in carmine. The walls of the cloaca genitalis contain at some little distance from the chitinous lining a sheath of loosely packed large muscle-fibres, which completely encircle the tube and run in a longitudinal direction. The fibres form several layers when seen in transverse

section, and are very conspicuous on account of their deep staining with carmine. The cloaca genitalis is very nearly as deep as

Text-fig. 27.



Cirrus sac of *Otiditænia eupodotidis*.

C. Extensions of genital cloaca. *C.S.* Expanded region of cirrus sac. *n.* Narrow region of sperm-duct. *x* in genital cloaca points to spines on "penis."

the length of the cirrus sac. When the entire system of genital ducts is seen in longitudinal section, *i. e.* in transverse sections of the proglottid, it will be observed that the cirrus sac projects into the cloaca genitalis, and that the latter is therefore prolonged backwards as a kind of collar surrounding the protrusible part of the cirrus sac. Dr. Gough has figured in *Stilesia hepatica** a similar backward growth of the cavity of the cloaca genitalis. In such longitudinal sections of the cloaca genitalis of *Otiditænia* it will be observed that the cavity is not so regular as I have seen it in transverse sections; there are lateral foldings of the lumen which are probably paired and thus produce no appearance of crumpling when the organ is viewed in transverse sections.

The vagina and cirrus sac, of course, open into this cloaca, the vagina nearer to the external orifice of the cloaca genitalis.

In following out a series of sagittal sections of the proglottids, which are, of course, transverse to the direction of the cloaca genitalis, it will be seen that, as a rule, the cirrus sac becomes separate from the vagina in a position which is at first obliquely anterior to the vagina. This is the same on both sides of the body; but it is not invariably that the cirrus sac thus opens into the genital cloaca anteriorly of the vagina. I have seen one case (text-fig. 28, p. 208) in which the vagina lay anteriorly to the cirrus sac, and in this case an obliquity occurred in the relative positions of the two tubes, but the obliquity was in the reverse direction to that shown in the normal arrangement. The obliquity, that is the more dorsal or ventral inclination of the cirrus sac to the vagina, is already known to vary; thus, in *Monieza* the position in relation to each other of the two tubes varies according as to whether they belong to the right or left side of the body, while in *Avitellina centripunctata* Dr. Gough has figured, in his paper already referred to †, an alternation of this kind in successive segments and on the same side of the body. There is, however, here no question of a reversal of an anterior to a posterior position such as I have found in *Otiditænia eupodotidis*.

In one case I found another remarkable variation. This was the complete absence of the proximal part of the vagina; into the cloaca genitalis opened only a cirrus sac. However, as the series of sections in which I observed this variation was traced further towards the middle line of the body, the median region of the vagina, which is of small calibre, came into view. In any case, the wide region of that tube which, in normal cases, opens into the cloaca genitalis was completely absent, save, indeed, for a few traces of its muscular longitudinal sheath.

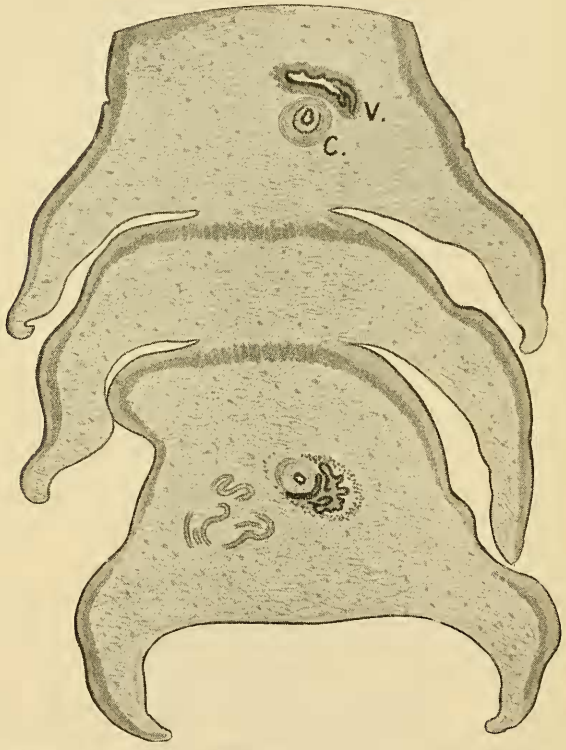
The *vagina* issues from the cloaca genitalis in an oblique position, as seen when the worm is studied in a series of sagittal sections, save, of course, for the exceptions mentioned above. It runs parallel with and later in close contact with the dense coil of

* "A Monograph of the Tapeworms of the Subfamily Avitellinæ," Quart. Journ. Micr. Sci. vol. lvi. 1911, pl. xii. fig. 16, *at*.

† *Loc. cit.* pl. xiv. fig. 43.

the vas deferens on the ventral side. At first the vagina is wide, with a much plicated lining epithelium surrounded by a thick layer of muscles. It then suddenly becomes much narrower—these two regions of the vagina being thus analogous to the wider distal sac-like part of the cirrus and the narrow proximal part of the same. The narrow region of the vagina joins the wider region at an angle. Followed back the narrow part of the vagina dilates with moderate abruptness into the large receptaculum seminis, which commences at a point about on a level with the pore side of the large ventral water vascular vessel.

Text-fig. 28.



Sagittal section showing different position of cirrus (*C.*) and vagina (*V.*) in two segments of *Otiditænia eupodotidis*.

The *cirrus sac* among the Tetracotylea occurs in at least two types of structure. One, the most general, is typified, for example, by that seen in *Stilesia* and represented in a figure in Dr. Gough's paper upon that genus and *Avitellina*, and discussed in a footnote concerning the cloaca genitalis. The second type, which is certainly not so general, is seen in a genus *Anoplotænia*, the anatomy

of which I have lately given an account to this Society *. In the former type, as will be seen in Dr. Gough's paper referred to, the cirrus sac contains a narrow cirrus which is protrusible from the sac and is of pretty well the same dimensions, through the sac not being at all wider at its free extremity. In *Anoplotænia* the cirrus-apparatus is divided into two regions; there is distally a protrusible sac of much greater calibre than the slender cirrus which is continuous with it posteriorly. The protrusible sac appears to be an ingrowth into the cirrus sac of the cloaca genitalis. It is this kind of terminal male apparatus which we find in the tapeworm which forms the subject of the present communication to the Society. I have examined into its structure both by transverse and longitudinal sections, and have found that it presents certain differences from the cirrus sac of *Anoplotænia*. It has already been said, in describing the cloaca genitalis, that the end of the cirrus sac protrudes into that cavity; how far it can be protruded without any further temporary dislocation of its parts I do not know. It is evident, however, that, as with *Anoplotænia*, so in *Otiditænia*, there is a terminal section of this apparatus which can be protruded, though I have not met with specimens in which the protrusion is actually effected. Text-fig. 27 (p. 206) shows a longitudinal section through a cirrus sac that is seen in a transverse section of the proglottid containing it. It will be seen that the whole organ is of considerable size, though not so large proportionately as it is in *Anoplotænia*. It is, however, of much the same shape, being a slightly elongated sphere, though flask-shaped when fully retracted. The sperm-duct in this particular specimen approaches the cirrus sac from one side, and then sharply curves to enter it. The point of entry is at the extreme posterior end, *i. e.* that furthest removed from the orifice of the cirrus sac into the cloaca genitalis.

The sperm-duct is a good deal coiled within the cirrus sac and has clear slightly stained walls. It does not, however, become enlarged anywhere to form a vesicula seminalis. The transition between the sperm-duct and the cirrus is abrupt. The cirrus is not, however, of greater calibre, or at most of very slightly greater calibre, than the sperm-duct with which it is continuous. The abruptness of the transition lies in the fact that the walls of the cirrus are thick and very deeply stained and the lumen proportionately reduced. The cirrus is very much shorter than the section of the sperm-duct which lies within the cirrus sac; it is slightly coiled. The cirrus itself again terminates abruptly in a wider sac. As will be seen in text-figure 27, this latter sac is flask-shaped, and, in fact, broadly corresponds in outline with the entire cirrus sac. The wider part of the flask lies within the wider part of the cirrus sac and the narrower part in the neck of the latter.

The whole sac is composed of a deeply staining epithelium,

* P. Z. S. 1911, p. 1003.

which is quite continuous above with the lining of the genital cloaca and below with the epithelium of the cirrus sac. The epithelium appears to be quite the same throughout this whole tract. It is clear, in fact, that both the narrow cirrus and the flask-shaped pouch into which it opens form one structure possibly invaginated from the genital cloaca, which is quite distinct morphologically from the sperm-duct. The cirrus sac itself is also divisible into two regions when it is occupied by the fully retracted cirrus, as shown in text-figure 27. The almost spherical distal part leads through a narrower neck to the cloaca genitalis. The spherical bulb is covered externally by a thin layer of muscle-fibres. The interior of the sac is filled with a tissue like that seen in the cirrus sac of other tapeworms, for example, in *Anoplotænia*, where I have represented its principal characteristics*.

There are many nuclei belonging apparently to delicate muscular fibres and forming a padding tissue between the contained coils of the male efferent system. Running from the wall of the cirrus sac furthest from the pore are muscular slips which are attached to the nearest end of the wide sac into which the cirrus opens and are doubtless retractile in function. The narrower neck-part of the cirrus sac is tubular and has a much thicker coating of muscles, which are circular in direction. This layer is one with the thin muscular coat of the bulb-region of the cirrus sac. Between this thick muscular coating and the terminal part of the male efferent apparatus which lies within it is seen a delicate muscular layer with abundant interspersed nuclei like the packing tissue of the bulb of the cirrus sac. The fibres, however, have a definitely longitudinal direction, and would seem to be part of the retracting apparatus.

It has been mentioned that the cirrus sac projects into the cloaca genitalis. The surface which thus projects is covered on that part of it which faces the external pore by close *chevaux de frise* of minute conical spines, which are not implanted hooks such as often occur upon the cirrus in tapeworms, but rather appear to be outgrowths of the cuticular covering. They suggest to some extent a comparison with a group of fine setæ described by Fuhrmann† in the two species *Anomotænia penicillata* and *A. isacantha* in an apparently similar situation.

The vas deferens immediately on leaving the cirrus sac forms a dense coil filling up a good deal of space. The tube is here wider than the sperm-duct within the cirrus, and the nuclei of the cells which constitute its walls are very obvious; the cells themselves are rather clear. I could find no vesicula seminalis along the course of the sperm-duct.

The *uterus* of this worm, together with its contents—the ripe or ripening embryos—shows certain definite peculiarities. At its first appearance the uterus is sac-like and narrow, lying in front of the ovaries and testes but still not very near to the anterior

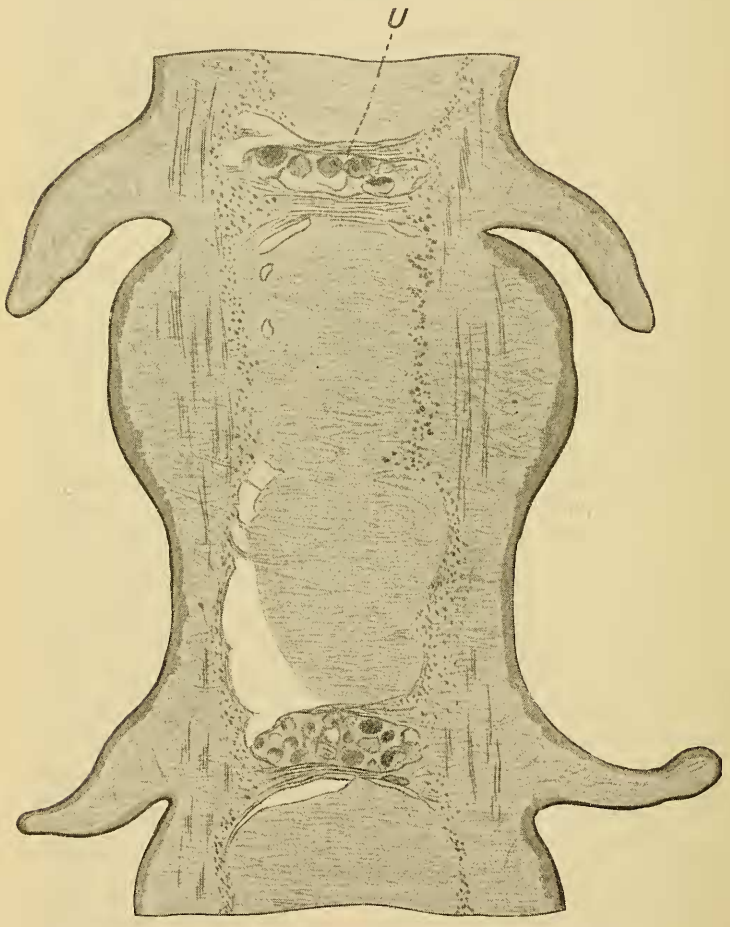
* P. Z. S. 1911, p. 1015, text-fig. 215.
† Centralbl. f. Bakt. u. Parasit. xlv. 1908, p. 516.

border of the segment. In this stage, when it is empty of eggs, it forms a narrow transversely running tube. In transverse sections of a slightly older uterus, such as that which is represented in text-figure 24 (p. 201), the position of this part of the reproductive organs is seen to be remarkable. If such sections be examined from in front backwards, the uterus is the first part of the generative system to come into view; for, although posterior in position in its segment, the uterus lies in front of the ovaries and testes. In such sections it appears first of all dorsally as a narrow and transversely elongated sac, not lying in the medullary parenchyma, but lying within the internal and circular layer of muscles which delimit the medullary parenchyma from the cortical layer—the body-wall of the worm. The uterus, so to speak, splits this circular layer of muscles into two layers, fibres being recognisable both dorsally and ventrally of it. It has probably pushed its way into this situation; but located there the appearance given is most suggestive of a cœlomic cavity lying between the body-wall and a central hypoblastic mass comparable to the reduced gut of certain simple Planarian worms (e. g. *Haplodiscus*). In such sections, moreover, the lumen of the uterus is seen to be not quite continuous from side to side of the body. Muscular fibres run across dorso-ventrally, which are of the nature of strands rather than septa. These are plainly shown in the accompanying illustration (text-fig. 29). Moreover, the epithelial lining of the uterus is quite alone in these transverse sections, its nuclei being very deeply stained.

This epithelial lining is continued over the strands of muscular tissue which partly divide up the cavity of the uterus. Although the uterus lies, as already said, below the dorsal parietes, there are here and there a few outpocketings of the cavity of the uterus, spherical in form, which push their way into the thickness of the dorsal parietes. Each of these contained only one or two groups of ovarian and vitelline cells, and in the case of one uterus I only found two of these small blind outgrowths. These transverse sections also show another fact in the constitution of the growing uterus, and that is its increased dorso-ventral diameter laterally, both on the pore side and on the opposite side. These dilated regions of the uterus were rather more liberally traversed by transverse strands than the rest of the cavity. The lateral widening of the uterus is also very plainly to be seen in horizontal sections, where it is visible even in rather younger proglottids than those just referred to. These longitudinal horizontal sections (see text-fig. 25, p. 202) also show very well the extension of the uterus on both sides of the body up to but not beyond the large ventral water vascular tubes. The cavity of the uterus is thus apt to be a little shorter from side to side than the space occupied by the testes. On the other hand, when viewed in a series of longitudinal sagittal sections, the uterus will be seen to have a greater dorso-ventral extension than the space occupied by the testes. In the three figures (text-figs. 24, 26, 29), which show

the gradual increase in importance of the uterus, it will be also observed that the total area occupied by the uterus and the rest of the generative organs diminishes in its proportion to the length of the segment in the older proglottids. It will also be noted that in the oldest proglottid figured (text-fig. 29) the testes are in course of disappearance.

Text-fig. 29.



Nearly mature proglottid of *Otiditænia eupodotidis*, sagittal section.

U. Uterus.

In the ripe proglottids which are in course of being detached the condition of the eggs is remarkable in several ways. The

segments, as has been pointed out in considering the external characters of this worm, are enormously swollen so as to be almost globular in form, except for the frill-like posterior end of each proglottid, where it overlaps the one next in order behind it. It would be easily supposed that this tension of the proglottids is simply a matter of their being gorged with ripe eggs, such a dilatation of proglottids seen in other tapeworms being due to this cause. A microscopical examination, however, of such proglottids shows that this conjecture is wrong. By far the greater part of the interior of the proglottid contains no uterus or egg at all. Fully three-quarters of the area of the proglottid is quite empty of eggs, and the medullary substance only contains a few fragmentary remains of other parts of the sexual system—as I suppose, for I have not identified the vestiges in question with any certainty. Moreover, the dilatation is not due to the imbibition of fluid during the processes of preservation. It was as obvious in proglottids shed during the life of the bird as in those extracted from the gut after death.

I have examined such proglottids in both transverse and longitudinal sections. Both sets of sections prove that the ripe eggs (or rather embryos) are only present posteriorly in the segment. In one proglottid, which was completely cut into sections and mounted upon ten slides, no less than seven of these slides showed no embryos at all scattered through the parenchyma; in another proglottid, however, treated in the same way, embryos were found to lie in the more anterior region, though here also the most anterior part of the proglottid was devoid of eggs. In both of these specimens, however, and in several others which I have examined by means of sections, the ripe embryos or masses of embryos by no means occupied the whole of the parenchyma. There were large tracts of parenchyma quite uninvaded by the uterus or its remains.

The fact that the masses of eggs may in some cases lie rather more anteriorly in the segment than they are apt to do in less fully ripe proglottids is, as I think, in favour of Dr. Benham's view that a scattering of eggs takes place owing to a rupture of the uterus when the proglottids come apart *. The parenchyma in these ripe proglottids must now be considered, as its condition is doubtless related to the changes in the uterus that remain for description. In younger proglottids, such as those represented in text-figure 24, the parenchyma is firm in appearance, moderately stained by carmine, and with abundant very well-stained nuclei; these nuclei seem to have a prevalently dorso-ventral arrangement in lines. Calcareous corpuscles are abundant, especially towards the posterior region of the segment, where the generative organs are situated. In still older proglottids, which, however, are not yet detachable from the strobila, such as those represented in text-figure 29, the medullary parenchyma has taken on a

* Quart. Journ. Micr. Sci. vol. xliii., 1900.

different appearance. It is much more distinctly fibrous than in younger proglottids, as is plainly shown in the text-figure just referred to. The fibres run, on the whole, dorso-ventrally, and thus appear transverse in sagittal sections. The fibrous appearance of the parenchyma is particularly obvious where the fibres are frayed out, owing to the breakage of the section. In such sections the calcareous corpuscles are still quite plain, chiefly massed posteriorly in each segment. And, finally, in proglottids of this age the uterus retains the perfect regularity of its shape.

We may now revert to the ripe detached or quite easily detachable proglottids. The same fibrous appearance of the medullary parenchyma is plain; but, owing to the swelling of the whole proglottid, the fibres no longer run entirely transversely in a dorso-ventral direction, but tend, in places at least, to be more circular in the way in which they lie.

This is especially the case in the neighbourhood of the uterus. In these segments, however, we can no longer speak of a uterus like that of the earlier proglottids represented in the series of text-figures already dealt with (text-figs. 24–29). In the completely mature proglottids (text-fig. 30) under consideration the embryos are in partly or wholly detached masses of roughly spherical form consisting of more or fewer individual embryos. These spherical sacs, though of course vestiges of the uterus, seem to have no definite walls of their own, but to be bounded only by the fibrous tissue of the medullary parenchyma. There are comparatively few of them, and those so small as to contain only one embryo are very few. The spherical masses of embryos are encircled by the fibres of the medullary parenchyma in such a way as to produce the impression of a definite sheath, which is perhaps particularly obvious in the case of two such masses lying close together. This statement applies to the larger as well as the smaller masses of ova. There is not, however, any very great development of this sheath, the character of its fibres being quite like that of the surrounding parenchyma. Otherwise, we might speak of paruterine organs; and, in any case, it is to be pointed out that we may have here just the commencement of the formation of paruterine organs, which is carried much further, but along the same lines, in such a genus as *Thysanotœnia**. I take it, however, that there is nothing sufficiently definite to allow of the assertion that the present genus or species is to be characterised by the possession of paruterine organs. Before comparing the history of the development of the uterus in this species with that of other forms it will be necessary to follow the development of the contained eggs.

In the uterus, when in such a stage of development as is represented in text-figure 24, there are comparatively few eggs. In many sections the cavity of the uterus, which is not yet very spacious, is seen to be completely empty. When ova are present

* See Beddard, "On Two Genera of Tapeworms," P. Z. S. 1911, p. 994.

they are small and delicate-looking, and not accompanied by much interstitial matter. The uterus itself at this stage has not very marked epithelial walls. The appearance of the ova is, indeed, that of masses of the ovary transferred bodily to the uterus. Later on the lining epithelium of the uterus is quite obvious especially so far as concerns the nuclei of the same. In the uterus of this and some later stages the individual eggs (or embryos, as the case may be) are by no means always in close contact with each other. They are separated by and imbedded in a great deal of interstitial substance, which, as a rule, stains very faintly with carmine.

Text-fig. 30.

Mature proglottid of *Otiditænia eupodotidis*, longitudinal section.

U. Chambers into which the uterus becomes divided.

It contains, however, a good many nuclei which do stain, and is thus evidently of a cellular nature. In the uteri of this

particular series of proglottids (shown in text-figure 25, p. 202) the accumulation of interstitial cells was chiefly in the uteral expansions close to the water vascular vessels. In these regions of the uterus the lumen was often entirely occluded by the densely packed contents. In the uterus of a later stage—that which is represented in text-figure 26—the embryos were firmly imbedded in the interstitial substance throughout the whole organ, so far as I could see. This substance appears much denser in the uterus of these older proglottids—so much so that cavities are left here and there from which an embryo has fallen out in the course of preparing the sections, which preserve exactly the spheroidal shape of the embryo. The interstitial matter also seems to take stains more readily at this stage, but exhibits no nuclei and no structure that I was able to unravel.

In the fully mature proglottids (see text-figure 30) this interstitial substance is still present, and the embryos are seen in the same way to be embedded in it, leaving cavities of exactly their shape when they chance to have fallen out. The interstitial substance, however, appears here to be rather laxer and is not so deeply stained. It is very possible that this matter lying between the eggs is a source of food-supply for the growing embryos. In *Avitellina centripunctata* Gough has described the fact that the eggs, after they have arrived in the uterus, "become surrounded by smaller cells derived from the walls of the uterus," as has been pointed out by Fuhrmann in the case of *Stilesia sjöstedti*. These cells are figured by Gough * as lying between and apparently completely filling the interstices between the eggs. These cells have conspicuous nuclei and are held by Gough to perform a nutritive function with regard to the eggs.

This final disposition of the uterus, or perhaps rather of its contents, in *Otiditænia eupodotidis* is not exactly like anything that is known to me at first hand or from the figures and descriptions of others. It is, however, suggestive of the figures that have been published of *Monopylidium* and even of *Davainea*. In his definitions of both of these genera (which are placed in separate families) Ransom † describes the fate of the uterus in almost exactly similar words: viz. "Uterus breaks down into (numerous) egg-capsules, each containing one or more (several) eggs." This is a little misleading in that the sharply contoured and thick-walled capsules of certain species generally assigned to the genus *Davainea* are different from the figures given of *Monopylidium infundibulum* etc. The definition would, moreover, apply to *Otiditænia*, in which, as I maintain, the conditions are really rather different from both.

In several species of *Monopylidium* the ripe eggs are scattered and imbedded singly in the medullary parenchyma, so far

* Gough, Quart. Journ. Micr. Sci. vol. lvi. pl. xiv. fig. 49.

† "The Tænioid Cestodes of North-American Birds," Bull. U.S. Nat. Mus. no. 69, 1909.

suggesting the genus *Oochoristica* *. Of *M. rostellatum* Fuhrmann writes † that each egg is surrounded by "une parenchyme vacuolaire qui forme . . . . . des cellules hexagonales." This is represented in a figure which suggests a definite limiting membrane to each of these "cellules," and thus separating them from the general medullary parenchyma. In *M. cayenneuse*, *M. secundum*, and *M. macracanthum* the same author ‡ finds the same singly imbedded ripe ova. And this condition appears to characterise some other species of the genus *Monopylidium*. There is, however, another species of tapeworm recently described from *Gallinula chloropus* under the name of "*Tænia marchali*" by Mola §, which Fuhrmann ‖ refers to the genus *Monopylidium*, in which the disposition of the ripe ova is rather different. Mola, in fact, figures the ova as not scattered singly through the parenchyma, but arranged in groups of one to six. Furthermore, he does not represent the parenchyma surrounding them as vacuolar (as does Fuhrmann in his species), but as distinctly fibrous. The state of affairs is therefore obviously much more like that of the species with which I am concerned in the present paper. Mola, however, does not show any tendency for the fibrous parenchyma to enwrap the bundles of eggs such as I have described above in *Otiditænia*. There is, furthermore, no suggestion given of an epithelial lining to the cavities which lodge the eggs in *M. marchali*.

Some important histological details are added by Clerc ¶ with reference to *Monopylidium infundibulum*.

In this species we have, as it would appear, an agreement with *M. marchali* in the fact that several ova are lodged together in one lacuniform cavity of the medullary parenchyma. But these cavities are not isolated; they form a complicated and irregular network of lacunæ **. Later still, however, the individual ova become more completely separated the one from the other, and the typical (?) character of the genus *Monopylidium* is arrived at. It may also possibly be the case with *M. marchali*. I have, however, no reason to suppose that the metamorphosis of the uterus in my genus *Otiditænia* proceeds any further than is indicated in

* *Cf.*, *e.g.*, Beddard, P. Z. S. 1911, p. 633, text-fig. 150, *e*.

† Rev. Zool. Suisse, t. xvi., 1908.

‡ Centralbl. f. Bakt. Parasit. Bd. 45, 1907.

§ Bull. Ac. Belg. 1907, p. 886.

‖ Die Cestoden der Vögel, Zool. Jahrb. 1908, Suppl.-Bd. x.

¶ Rev. Zool. Suisse, t. xi. 1903, p. 354. Ransom places this species in the genus *Choanotænia* on the grounds of his own observations as well as those of Cohn (Nova Acta Ac. Nat. Cur. Bd. lxxix., 1901), which seem to show that the uterus is persistent "and possesses an irregularly lobulated cavity incompletely subdivided by infoldings from the wall." This is, according to Ransom, a character of *Choanotænia*, and contrasts with the breaking up of the uterus in *Monopylidium*, which I have referred to above. I may point out, in support of Clerc, that Cohn's figure (*loc. cit.* pl. 32. fig. 47) may well indicate an incompletely mature uterus, since he represents in the same proglottid both ovaries and testes. In *Otiditænia*, at any rate, the ovaries and testes have disappeared when the uterus is fully mature. Cohn's figure may correspond to a stage figured in text-figure 30 of the present memoir.

** *Loc. cit.* vol. xi. figs. 73, 77, 85.

text-figure 30. Clerc also figures somewhat similar changes in the uterus of a species of *Dilepis* * (not named), where the scattered ova actually penetrate the cortical parenchyma. This fact I have also observed in *Otiditænia*.

There are, therefore, clearly differences of importance between the ultimate fate of the uterus in the two genera—as I regard them—*Monopylidium* and *Otiditænia*. In the former the eggs are in most (? in all) species finally scattered through the parenchyma unaccompanied by any other cells such as occur with the ova in *Otiditænia*, in which genus the eggs are at the very end grouped into many more or less isolated but not well-marked capsules. There remains a comparison of the uterus of *Otiditænia* with that of *Davainea*. With regard to certain species of the latter there is no particular comparison possible. But Clerc has figured the egg-capsules of *Davainea frontina* †, which do seem to present certain similarities to the egg-capsules of *Otiditænia eupodotidis*. In the former worm the egg-capsules differ from those of such a species as *D. comitatus* ‡ in that the individual eggs do not lie closely together within the capsule, but are more or less widely separated with a good deal of interstitial matter between them, which the author regards as a part of the medullary parenchyma which has undergone alteration. This and the enclosed eggs is surrounded by a definite layer of cells, which are not to be looked upon as a part of the persisting walls of the uterus, since in that case they would not enclose a portion of the medullary parenchyma. If this interpretation of the facts be correct, there is clearly no possible correspondence with the phenomena which I myself describe in the present paper. It seems to me, however, to be not impossible that the supposed altered parenchyma-cells which lie amongst the ova are really the equivalents of the similarly placed cells in my genus *Otiditænia*. Moreover, Ransom § speaks of cells accompanying the scattered ova of *Davainea rhynchota*.

I am disposed, however, to think that there is another view to be taken of the egg-capsules of *Davainea frontina*, as figured by Clerc. From the account that he gives of them in the text and of the investigations of others on the same subject—to which we may add those of Leuckart ‖—it seems clear that the egg-capsules correspond to the paruterine organs of a genus recently described by myself ¶ under the name of *Thysanotænia*, as I have already suggested. In this case we cannot agree with the statement of Ransom, in defining the subfamily Davaineinæ, that the "uterus breaks down into numerous egg-capsules." For in *Thysanotænia* there is, I think, no doubt that the cases in which the eggs finally come to lie have nothing whatever to do with the uterus, and are,

* Clerc, *loc. cit.* pl. xi. figs. 75, 76.
† *Loc. cit.* pl. xi. fig. 80.
‡ Ransom, Bull. U.S. Nat. Mus. no. 69, p. 17, fig. 8, *cap.*
§ *Loc. cit.* p. 14.
‖ Quoted in Bronn's 'Thierreichs,' p. 1445.
¶ P. Z. S. 1911, p. 1000.

in fact, paruterine organs. This is not the case with the sacs of eggs in *Otiditœnia*.

We may abstract from the foregoing account of the anatomy of this worm the following *résumé* of its structural characters:—

Length about 3 inches; greatest breadth 4 mm. Scolex with feebly developed rostellum with a marginal double circle of very numerous and small hooks. Suckers unarmed and rather large. Neck present and short. Proglottids broader than long, except at the extreme end of the body, where they become rather longer than broad. Completely mature proglottids almost spherical, except for the frill which overlaps the following proglottid. Two excretory tubes on each side, of which the ventral are very wide and the dorsal narrow; the two are at times parallel, but occasionally the dorsal tube is really somewhat dorsal in position. Ventral vessels joined by a wide cross-trunk at the posterior end of each proglottid. Generative pores alternate irregularly; the generative ducts pass between the dorsal and ventral trunks of the excretory system. The generative pores are not borne at the end of outgrowths of the proglottid. The testes lie at the extreme end of the proglottid and form a vertical wall of over 200 separate gonads, which, however, are included in a mass of medullary tissue rather different from the medullary parenchyma generally. The sperm-duct forms a large coil, and is also slightly coiled within the rather large cirrus sac. In the latter the actual cirrus is short and is connected with a wider (? eversible) tube also contained within the cirrus sac. The cloaca genitalis is deep. The ovary and vitelline gland lie in front of the testes. The vagina is furnished with a large receptaculum seminis. It opens into the cloaca genitalis behind and at right angles to the cirrus sac. The uterus lies in front of the ovary, and in mature segments the whole reproductive system is restricted to the posterior fifth or so of the proglottid. The uterus is a narrow transverse tube, wider at the two sides. Later it is broken up into several more or less spherical compartments. The eggs are imbedded, within the uterus, in a mass of cellular tissue whose origin is uncertain, and which later loses its cellular character.

We have now to consider whether the species described in the present communication can be referred to any known genus or whether it will be necessary to form a new genus for its reception. The abstract of the anatomical characters that has just been given shows that the worm is undoubtedly a member of the large family Hymenolepididæ or perhaps of the Davaineidæ. This conclusion need not be proved in detail. Furthermore, it is clear that the features which distinguish it, viz. the following assemblage of characters, necessitate its inclusion in one of the genera *Monopylidium*, *Choanotœnia*, or *Anomotœnia* of the Hymenolepididæ, or to a new genus altogether. These characters are:—Armed rostellum and unarmed suckers; large number of proglottids; alternate generative pores; absence of paruterine organs; testes behind ovaries; breaking up of uterus in ripe segments; and in

a number of points which we shall have to consider in fixing the position of this worm. It is true that the three genera mentioned are separated by somewhat slender characters, which is emphasized by the fact that *Choanotœnia infundibulum* has been referred by Fuhrmann to the genus *Monopylidium*, and that the same author has left the position of *Choanotœnia lævigata* of Rudolphi in doubt.

All the three genera, however, seem to differ from that which forms the subject of the present paper by the strong muscular rostellum and by the relatively small number of the hooks, arranged in a single or a double crown. Moreover, the segments in representations of these genera are figured as considerably longer in proportion to their breadth than they are in *Otiditœnia*. Finally (so far as concerns the more important point), the uterus appears to be a persistent and continuous sac in *Choanotœnia* and *Anomotœnia*, while the eggs in *Monopylidium* come to be scattered singly through the parenchyma. As I have endeavoured to show on a previous page *, the development of the uterus in *Otiditœnia* is different. Nevertheless, I am disposed to place *Otiditœnia* more nearly in the neighbourhood of these genera than in that of any others.

With regard to the Davaineidæ the present genus does undoubtedly show certain points of likeness to the genus *Davainea*, the definition of which genus is not, however, a matter of great ease. *Otiditœnia* certainly lacks hooks upon the suckers, the existence of which in *Davainea* forms a part of its generic definition. But it must be remembered that *D. lateralis* from the mammal *Galeopithecus* has suckers without hooks. The breadth of the rostellum and its numerous hooks is a point of similarity to *Davainea*, in which genus the rostellum may be rather rudimentary (*cf.* Zschokke †). The principal reason, however, against assigning this worm from *Eupodotis kori* to the genus *Davainea* is the persistence of the uterus to the stage of the perfectly ripe proglottids, whereas in "the genus *Davainea* a definite functional uterus is not developed" (Ransom) ‡, and there are also paruterine organs.

The generic § characters of **Otiditœnia** will be, as I believe, the following:—

Scolex with wide but rather rudimentary rostellum armed with over a hundred minute hooks arranged in two rows. Suckers unarmed. Neck present, not long. Proglottids for the most part wider than long, only as wide or slightly wider than long at the end of the body. Genital pores irregularly alternating. Detached proglottids very swollen, almost spherical. Water vascular vessels two pairs, ventral much the larger, nearly or quite lateral to each other; transverse trunks also wide. Genital organs not mature very early

* P. 210.
† Centralbl. f. Bakt. u. Parasit. 1895, p. 634.
‡ Bull. U.S. Nat. Mus. no. 69, 1909, p. 14.
§ I do not feel able to differentiate the specific characters.

in strobila. Testes numerous, at least 200 *lying posteriorly in a thin vertical plate extending between water vascular vessels and even beyond them laterally, imbedded in interstitial tissue different from medullary parenchyma. No vesicula seminalis, sperm-duct with large coil; cirrus sac large, containing a looped part of sperm-duct, short cirrus, and an evaginable sac derived from cloaca genitalis. Ovaries and vitelline gland in front of testes. Uterus in front of ovaries, a narrow transverse sac with cavity partly divided by ingrowing trabeculæ. Later uterus converted into several spherical sacs. Eggs thin-walled, surrounded by nutritive (?) cells.*

Hab. *Eupodotis kori.*

The most noteworthy characters of the genus, so far as the external characters go, appear to be the rather wide and rudimentary rostellum, which is, nevertheless, armed with very numerous though very minute hooks. The internal structure is remarkable for the restriction of the gonads to the extreme posterior part of each segment, and to the fact that the very numerous testes arranged only one deep are imbedded in a very different kind of medullary parenchyma, which is obvious to the eye on account of its feeble staining: by the peculiar form of the cirrus sac and the inclusion within it of an outgrowth of the genital cloaca, which is probably protrusible like the somewhat similar "penis" of *Anoplotænia*: and by the fate of the uterus and the presence of interstitial cells lying among the eggs.

14. On the Milk-Dentition of the Ratel.

By R. Lydekker.

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(Text-figures 31 & 32.)

Many instances are known among extinct mammals in which the milk-dentition presents primitive features entirely lost in the teeth of the permanent series. In the equine *Merychippus*, for example, the cheek-teeth of the milk-series are of the short-crowned cementless type of *Anchitherium*, whereas those of the permanent set show the high-crowned and cemented type characteristic of the more specialised representatives of the family Equidæ *. So far, however, as I am aware, no such atavistic features have been recorded in the case of any existing mammals; and it is therefore of interest to bring to notice what appears to be a case of this nature.

In the ninth edition of the 'Encyclopædia Britannica,' Sir William Flower classed the Ratels (*Mellivora*) with the Badgers in the subfamily Melinæ; this classification was followed in Blanford's volume on Mammalia in the 'Fauna of British India' † and in Flower and Lydekker's 'Study of Mammals' ‡.

* See Lull, Amer. J. Science, vol. xxiii. p. 177, 1907.
† Page 175, 1888. ‡ Page 576, 1891.